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(54) Gap former in a paper machine.

(57) The invention concerns a gap former in a paper machine, whose twin-wire zone (B-C) comprises a combination of the following web-forming and dewatering units (a)...(d), which are placed in the given sequence in the running direction of the web (W) that is formed :

(a) a forming gap (G), which is defined, at one side, by one of the wires (10 ;20), which runs over the open face (11' ;21') of the first forming roll (11 ;21), and by the substantially straight run of the opposite wire (20 ;10), starting from its guide roll (21A ;11A) to the next forming member (22 ;12) ;

(b) a forming shoe (12 ;22) provided with a curved ribbed deck (12a ;22a), whose curve radius is $R_1 > 2...8$ m, the tangential direction of the inlet side of the ribbed deck (12a ; 22a) of said forming shoe (12 ; 22) substantially coinciding with the principal direction of the forming gap (G) ;

(c) a MB unit or units (50), comprising a dewatering unit (40) and a press and support unit (60) placed one opposite to the other, the sets of ribs (80,70) in said units pressing the web (W) to be formed between the wires (10,20) ; and

(d) a large-diameter (D_2) second forming roll (23), which includ s suction zones (23a,23b), in or after the area of which suction zon s (23a) the covering wire (10) is separated by means of the guide roll (14') from the web (W), which is passed furth r on the carrying wire (20).

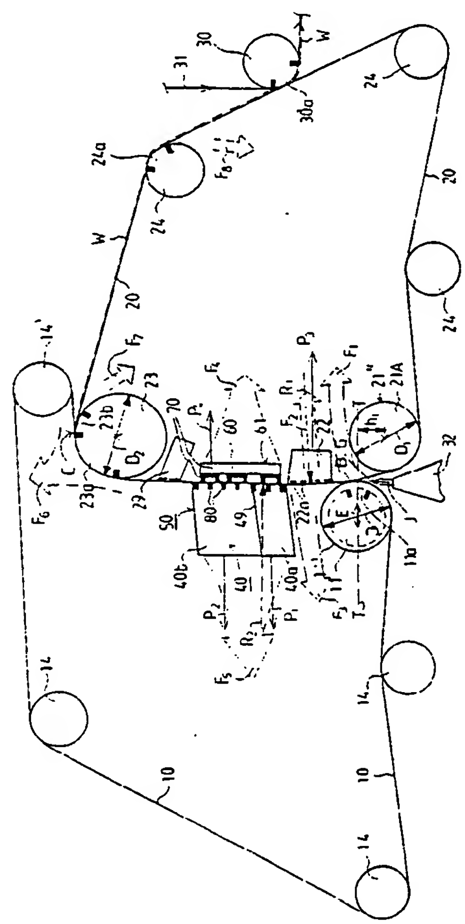

FIG.1

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The invention concerns a gap former in a paper machine, comprising the loop of a carrying wire and the loop of a covering wire, which together form a twin-wire zone, which starts from the forming gap, into which the slice part of the headbox feeds the pulp suspension jet, and after which twin-wire zone the web is separated from the covering wire and is transferred on the carrying wire onto a pick-up fabric.

With increased running speeds of paper machines, several problems in the web formation have been manifested with increased emphasis. In the former section of a paper machine, the phenomena that act upon the fibre mesh and upon the water, which is still relatively free in connection with the fibre mesh, such as centrifugal forces, are, as a rule, increased in proportion to the second power of the web speed. The highest web speeds of existing newsprint machines are of an order of 1500 metres per minute. However, newsprint machines are being planned in which a web speed of up to about 2000 m/min is aimed at.

The object of the present invention is further development of the formers described in the applicant's FI Patent Application 751774 (equiv. to US Pat. 3,996,068) and FI Patent Applications 851650, 852662, and 902283, which formers are marketed by the applicant under the trade mark "Speed-Former". The "Speed-Former" formers can be characterized as gap-roll-shoe formers. In said "Speed-Former" former, need of further development has been noticed in particular in the case of papers made of slowly draining pulp qualities, such as SC-paper, and with particularly high machine speeds. In view of satisfying said need of development so that a sufficiently high dry solids content after the wire part can be guaranteed with all web grades and web speeds in use, the former has been developed that is described in the applicant's said FI Pat. Appl. 902283, in whose gap-roll-shoe-roll former a considerable proportion of dewatering is carried out on the last (second) forming roll, in connection with which roll the necessary dewatering equipment is fitted so that, on the last forming roll, the dry solids content of the web is still raised by about 3...5 per cent.

With respect to the prior art related to the present invention, reference is also made to the US Patent No. 4,769,11 of Messrs. A. Ahlstrom Corporation, to the applicant's FI Pat. Appl. No. 885609, as well as to the FI Pat. Appls. Nos. 885606 and 885607 of Messrs. Valmet-Ahlstrom Inc., in which formers marketed under the trade mark "MB-former" are described.

In the roll-gap formers mentioned above, the pulp suspension is passed from the headbox into a gap formed by a forming roll and by two wires, after which gap the two wires and the pulp layer placed between them follow the curve form of the forming roll, most of the water being drained through the wires. The necessary dewatering pressure is produced by means of the tension of the outer wire, which tension produces a pressure in the pulp layer, which pressure is proportional to the wire tension and inversely proportional to the curve radius of the forming roll. In the gap, part of the kinetic energy of the pulp jet is converted to pressure energy, and the jet speed is lowered accordingly. The dewatering through the outer wire away from the forming roll is intensified by the centrifugal force. Dewatering towards the forming roll can be intensified by means of negative pressure in a zone of the forming roll.

With respect to the prior art related to the present invention, reference is further made to the applicant's FI Patent Applications 904489 and 920863. In the former application, a roll-gap former is described, in which it has been considered novel that said dewatering unit or units comprise(s) a stationary press-support unit, which guides the wire that enters into contact with said unit as a substantially straight run, and that said dewatering unit or units comprise(s) a dewatering equipment placed facing said press and support unit and provided with a suction and foil equipment, said equipment removing a substantial amount of water out of the web.

One basic type of a twin-wire former is the so-called ribbed gap former, in which the discharge jet of the headbox is passed into the gap formed by two wires, which gap becomes narrower either as a substantially straight dewatering area formed by means of dewatering ribs placed at both sides of the wires transversely to their running direction or as one or two successive curved dewatering areas in which the ribs are placed at the side of the curve centre of the wires. In respect of these formers, reference is made to the US Patents 3,578,558, 3,944,464, 4,125,428, to the DE Published Patent Application 21 13 014, and to the FI Published Patent Application No. 50,647.

In the FI Pat. Appl. No. 913480, which was originally applied for by Messrs. Tampella Papertech Oy, a gap former is described, wherein it has been considered novel that the breast roll that guides the first wire is open, and the narrowed discharge jet meets the first wire in the area of contact with the open roll and the second wire after the br ast roll that guides said second wire, the distance b tween the wire placed on the open breast roll, at the point of separation of the first wire from the breast roll, and the second wire, which is placed between its own breast roll and a guide member, is smaller, preferably 1...4 mm smaller, than the thickness of the narrowed discharge jet.

Th object of th present invention is further development of the prior art described abov so that a nov l gap former is provided by whose m ans both good formation of the web and good retention can be achieved.

It is a further object of the invention to provide a former whose dewatering capacity is sufficient also at high web speeds and with thicker paper grades.

It is a further object of the invention to provide a former in which the advantages of the gap part of the former described in the above FI Pat. Appl. 913480 are accomplished and in which a dewatering unit of the MD type can b made to operate in an optimal range of dry solids content of the web.

Further, it is an object of the invention to provide a former in which the ratio of tensile strength machine direction / cross direction MD/CD of the paper produced can be made ever lower while, nevertheless, maintaining good formation and retention. In relation to the above, an object of the invention is to provide a former in which, if necessary, it is possible to achieve a ratio of tensile strength of the paper MD/CD $\leqq 2.5$.

In view of achieving the objectives stated above and those that will come out later, the invention is mainly characterized in that the twin-wire zone comprises a combination of the following web-forming and dewatering units, which are placed in the given sequence in the running direction of the web that is formed and which are known in themselves:

(a) a forming gap, which is defined, at one side, by one of the wires, which runs over the open face of the first forming roll, and by the substantially straight run of the opposite wire, starting from its guide roll to the next forming member;

(b) a forming shoe provided with a curved ribbed deck, whose curve radius is $R_1 > 2...8$ m, the tangential direction of the inlet side of the ribbed deck of said forming shoe substantially coinciding with the principal direction of the forming gap;

(c) a MB unit or units, comprising a dewatering unit and a press and support unit placed one opposite to the other, the sets of ribs in said units pressing the web to be formed between the wires; and

(d) a large-diameter second forming roll, which includes a suction zone or suction zones, in or after the area of which suction zone the covering wire is separated by means of the guide roll from the web, which is passed further on the carrying wire.

After the MB unit or units and before the large-diameter second forming roll, preferably a suction box is placed either inside the carrying wire or inside the covering wire, as a rule preferably inside the carrying wire.

In the following, the invention will be described in detail with reference to some exemplifying embodiments of the invention illustrated in the figures in the accompanying drawing, the invention being by no means strictly confined to the details of said embodiments.

Figure 1 is a schematic side view of a former in accordance with the invention in which there is a vertically rising twin-wire zone and in which the open-faced forming roll in the gap area is placed inside the loop of the covering wire.

Figure 2 shows a twin-wire zone in the other respects similar to Fig. 1 except that the MB unit is in a position inverse in relation to Fig. 1.

Figure 3 is an illustration corresponding to Fig. 2 of a twin-wire zone in which the open-faced forming roll in the gap area is placed inside the loop of the carrying wire.

Figure 4 shows a twin-wire zone in the other respects similar except that the MB unit is placed in a position inverse in relation to Fig. 3.

Figure 5 shows a former in accordance with the invention in which the principal direction of the twin-wire zone is horizontal and the forming roll in the gap area is placed inside the loop of the upper wire, which operates as the covering wire.

Figure 6 shows the initial part of the twin-wire zone and the gap area in a former which is in the other respects similar to that shown in Fig. 5 except that the open forming roll is placed inside the loop of the lower wire, which operates as the carrying wire.

Figure 7 shows an exemplifying embodiment of a MB zone applied in the invention, which zone is in the other respects similar to that shown in Fig. 3 except that the forming shoe is placed inside the loop of the carrying wire.

Figure 7A shows the detail A indicated in Fig.7 on an enlarged scale.

To begin with, the common features of the twin-wire formers illustrated in Figs. 1 to 6 will be described. The former comprises the loop of the covering wire 10 and the loop of the carrying wire 20. Between the lines B-C, the wires 10 and 20 form a twin-wire zone, in which water is removed from the web W through both of the wires 10,20. The covering wire 10 is guided by the guide rolls 14,14' and by the first forming roll 11 or the corresponding breast roll 11A directly. The forming gap G, which becomes narrower as wedge-shaped, is defined between the covering wire 10, which is guided by the forming roll 11 or the corresponding br ast roll 11A, and the carrying wire 20, which is guided by the forming roll 21 or th corresponding breast roll 21A. It is essential that the wires 10,20 have no common curve sector on the first forming roll 11;21, but the principal direction of the forming gap G and the joint run of the wires 10,20 following after th gap is straight until the inlet edge of the forming sho 12,22. The forming gap G is determined by the first open-faced 11';21' forming roll 11;21 and by the smooth-faced 11";21" breast roll 11A;21A, which is placed before said forming roll in the feed dir ction of the pulp j t J. In such a cas , th forming gap G is defin d, at on side, by the substantially straight

run of the wire 10;20 from said breast roll 11A;21A to the inlet edge of the forming shoe 22 and, at the other side, by the opposite wire 20;10 curv d on the open face 21';11' of the first forming roll 21;11, which opposite wire departs from the open face 21';11' of the forming roll 21;11 in the area of the bottom of the gap G. In the area of the gap G, when the wire 10;20 runs on the open face 11';21' of the first forming roll 11;21, dewatering takes place into said open face 11';21' and through the substantially straight run of the opposite wire 20;10. Thus, what is concerned is a so-called "kissing forming roll" (11;21). By means of the gap geometry described above, the controllability and the transverse stability of the wires can be improved to some extent in comparison with a case in which the forming gap G would be more open at the forming roll 11;21 than the "kissing forming roll" 11;21.

In the twin-wire zone, after the forming gap G, there is a curved forming shoe 12;22, which has a ribbed deck 12a;22a with a large curve radius R_1. The forming shoe 12;22 is followed by the MB unit 50 in the twin-wire zone, which unit consists of a dewatering unit 40 and a press and support unit 60 operating one opposite to the other, the wires 10,20 being pressed against one another by means of the latter unit so as to remove water out of the web W placed between the wires.

There may a higher number of said MB units 50, for example two, placed one after the other and preferably arranged so that in the successive units 50 the units 40 and 60 are placed inside different wire loops 10,20.

The MB unit 50 or units is/are followed by a suction box 29, which is provided with a ribbed deck and which is placed inside the loop of the carrying wire 20. The suction box 29 is followed by a large-diameter D_2 second forming roll 23, which is placed inside the carrying wire 20, which is a suction roll, and in which there are two successive suction zones 23a and 23b, according to Figs. 1 to 4, and one suction zone 23a, according to Fig. 5. The diameter D_2 of the second forming roll 23 is, as a rule, chosen in the range of $D_2 \approx 1.0...2.0$ m. The covering wire 10 is separated at the line C from the covering wire 20 by means of the guide roll 14', the web W following said carrying wire 20. According to Figs. 1 and 5, the web W is passed further on the suction zone 24a of the wire 20 suction roll 24 and from there further as downwards inclined to the pick-up point, where the web W is transferred onto the pick-up fabric 31 on the suction zone 30a of the pick-up roll 30. After this, the carrying wire 20 continues its run, guided by the guide rolls 24, onto the breast roll 21A in the gap area (Figs. 1, 2 and 5) or onto the forming roll 21 placed in the gap area, which forming roll has an open face 21' which receives water (Figs. 3 and 4).

According to Figs. 1 to 4, the main direction of the run of the twin-wire zone B-C is vertical. The twin-wire zone starts in the forming gap G, into which the slice part 32 of the headbox feeds the pulp suspension jet J. The jet J is directed towards the bottom of the straight gap G which becomes narrower as wedge-shaped.

According to Figs. 1 and 2, inside the loop of the covering wire 10, there is a forming roll that is provided with an open face 11' and that receives water. On a level lower than said forming roll 11, at the distance of the height difference h_1, inside the loop of the carrying wire, there is a breast roll 21A provided with a smooth solid face 21". The diameters D_1 of the rolls 11 and 21A are preferably substantially equal in comparison with one another, being of an order of $D_1 \approx 0.5...1.5$ m, preferably $D_1 \approx 0.7...1.0$ m. With the above roll diameters D_1, said difference in height h_1 is preferably in the range of $h_1 \approx 50...300$ mm. The forming roll 11 may also be a suction roll provided with an inside suction chamber 11a, the negative pressure employed in said roll being preferably in the range of $p_0 \approx 10...20$ kPa. In Fig. 1, the outlet end of the forming gap G is in the horizontal plane T-T determined by the central axis of the first forming roll 11 or near said plane.

According to Figs. 3 and 4, the water-receiving forming roll 21 provided with an open face 21' is placed inside the loop of the carrying wire 20, and the breast roll 11A provided with a smooth face 11" is placed inside the loop of the covering wire 10. For fine adjustment of the gap geometry, the forming roll 11;21 is arranged so that its position can be adjusted substantially in the horizontal plane (arrow E).

The gap area is substantially immediately followed by the forming shoe 12;22. The forming shoe 12 shown in Figs. 3 and 4 is placed inside the loop of the covering wire 10, and the forming shoe 22 shown in Figs. 1,2,5 and 6 is placed inside the loop of the carrying wire 20. The forming shoes 12;22 are provided with a ribbed deck of a large curve radius R_1. The curve radius R_1 is usually chosen within the range of $R_1 \approx 2...8$ m, preferably in the range of $R_1 \approx 3...5$ m. If necessary, the box of the forming shoe 12;22 may be connected to negative pressure p_3, which is illustrated by the corresponding arrow in Fig. 1. The negative pressure p_3 promotes the draining through the gaps in the ribbed deck 12a;22a. However, in the area of the forming shoe 12;22, the dewat ring takes place primarily apart from the shoe by the effect of the pressure $p_T = T/R_1$ produc d by the tightening tension T of the wires, which dewat ring is aided by centrifugal forces.

The forming shoe 12;22 is substantially immediately followed by the MB unit 50, which, according to Fig. 1, comprises two draining chambers 40a and 40b, which are fitted inside the loop of the covering wir 10, which are separated from one another by a partition wall 49, and both of which communicate with different negative pressures p_1 and p_2. At the side of the chambers 40a and 40b placed against the twin-wire zone, there is a set of ribs 80. The press and support unit 60 is provided with a corresponding set of ribs 70, and th construction

and the operation of said sets of ribs 70,80 will be described in more detail later with reference to Figs. 7 and 7A. The box 61 in the press and support unit 60 can also, if n cessary, be connected to negative pressure p_4.

According to Fig. 2, the units 40 and 60 operating one opposite to the other in the MB unit 50 are placed in an inverse order, compared with Fig. 1, so that in Fig. 2 the dewatering unit 40 is placed inside the loop of the carrying wire 20 and the press and support unit 60 is placed inside the loop of the covering wire 10. The MB unit 50 or units is/are followed by a suction box 19, which is fitted inside the loop of the covering wire 10 and which is provided with a ribbed deck provided with slots and operating against the inner face of the wire 10.

According to Fig. 3, the dewatering unit 40 of the MB unit 50 is placed inside the loop of the carrying wire 20, and the press and support unit 60 inside the loop of the opposite wire 10, whereas in Fig. 4, compared with Fig. 3, the units 40 and 60 are placed in an inverse order. The principal direction of the twin-wire zone guided by the sets of ribs 80,70 in the units 40 and 60 is straight, but alternatively it is possible to use a ribbed zone 70,80 whose principal direction is slightly curved, the curve radius of said zone being denoted with R_2 in Figs. 1 and 2. Said curve radius R_2 is, as a rule, chosen within the range of $R_2 \approx 3...8$ m. In Fig. 1, the centre of curvature of R_2 is placed at the side of the dewatering unit 40, and in Fig. 2 at the side of the press and support unit 60.

Figs. 5 and 6 show two horizontal versions of a gap former in accordance with the invention. According to Fig. 5, the gap G is determined by the lower breast roll 21A, which has a smooth solid face 21", and by the upper forming roll 11, which is provided with an open face 11' that receives water. Between the rolls 21A and 11, there is a horizonal distance v_1. The upper forming roll 11 has been arranged adjustable mainly in the vertical direction (arrow E) in view of fine adjustment of the gap geometry. In Fig. 6, in the area of the gap G, in the horizontal direction, there is first a breast roll 11 provided with a smooth face 11' and a lower forming roll 21 which is provided with an open face 21', the horizontal distance between said rolls being v_1, which is, as a rule, in the range of $v_1 \approx 50...300$ mm.

According to Figs. 5 and 6, the forming gap G is followed by a forming shoe 22 placed inside the loop of the lower wire 20, which forming shoe is provided with a ribbed deck 22a of a curve radius R_1. After that, there follows the MB unit 50, which comprises a first water drain chamber 41, placed above the forming shoe 22 inside the loop of the upper wire 10 in the way shown in Fig. 6, said chamber having a water drain duct 42 preferably at the driving side of the machine only. Underneath the first chamber 41, a gap space 43 remains, through which the water is drained, aided by negative pressure p_1, through the suction-deflector duct 44 in the direction of the arrow V_1 into the chamber 41 and from it further through the duct 42 to the side of the paper machine and into the wire pit. In the direction of the arrow V_1, through the suction-deflector duct 44, mainly water that has been separated from the web W through the upper wire 10 in the area of the shoe 22 is drained. The first water drain chamber 41 is followed directly by a second water drain chamber 45, in connection with whose rear wall there is a water drain duct 47. Through the duct 47, water is drained in the direction of the arrow V_2 through the slot gaps in the sets of ribs 80 in the dewatering unit 40, and these waters are removed out of the chamber 45 through a water drain duct 46, which is placed preferably at the operating side of the machine only. Against the set of ribs 80, a set of ribs 70 operates which is loaded by means of the pressure of the pressure medium of the press and support unit 60, and the construction and the operation of said sets of ribs 70,80 will be described in more detail in the following with reference to Figs. 7 and 7A.

The MB unit 50 or units is/are followed by a suction box 29, which is placed inside the loop of the carrying wire 20 and which is provided with a ribbed deck that includes slots. After the suction box 29, the twin-wire zone is curved in the suction zone 23a of the second forming roll 23 to become downwards inclined, and the web W is separated from the upper wire 10 and guided to follow the lower wire 20, being assured by the negative pressure present in the ribbed deck 25a of the suction box 25 placed inside the loop of the lower wire 20.

In Figs. 7 and 7A, directly after the curved ribbed deck 22a of the forming shoe 22 and inside the loop of the carrying wire 20, the dewatering unit 40 of the MB unit 50 is fitted. Inside the loop of the covering wire 10, there is the press and support unit 60 of the MB unit 50, whose construction comes out in more detail from Fig. 7A. The unit 60 includes a set of ribs 70, which consists of ceramic loading ribs 71,72, which are interconnected in pairs by means of support structures 73. The ribs 71,72, and so also their back-up ribs 81, extend in the transverse direction across the entire width of the web W and of the wires 10,20. The set of ribs 70 is loaded by means of pressures p_k passed into the loading hoses 75 against the stationary frame constructions 74. Into the hoses 75, pressures p_k are passed through the pipes 77 out of the source 76 of negative pressure, which is illustrated just schematically. The units 40 and 60 may also change places with one another.

As is shown in Fig. 7A, the s t of ribs 80 of the equipm nt 40 placed inside the loop of th carrying wire 20 consists of forming ribs 81, which are attached to the frame constructions 84 by means dovetail joints. The ribs 81 are placed as alternating with, not directly opposite to, the ribs 71,72 in the set of ribs 70 so that, being guided by the sets of ribs 70,80, the twin-wir zone runs between the units 40,60 along a very gently mean-

dering path, whose principal dir ction is straight or curved and whose curve radius is, in Figs. 1 and 2, denoted with R_2. If necessary, in the area of the MB unit 50 the dewatering can be intensified by means of the effect of negative pressures p_1,p_2,p_4 present in the gaps between the ribs 71,72,81. The symmetry of dewatering and of web formation can be controll d by means of regulation of said levels of negative pressure p_1,p_2,p_3,p_4 in the units 40 and/or 60. According to Fig. 7, the dewatering equipment 40 has been divided by a partition wall 49 into two compartments 40a and 40b, each of which communicates separately with a suction pump, so that the compartments 40a and 40b can be provided with negative pressures p_1 and p_2 of different levels to promote the dewatering.

In Fig. 1, the dewatering proportions at the different dewatering units are illustrated by the arrows $F_1,F_2,F_3,F_4,F_5,F_6,F_7$ and F_8. One particularly favourable distribution of the dewatering proportions that can be accomplished in a former in accordance with the invention is the following:

$F_1 \approx 15$ %	$F_2 \approx 27$ %	$F_3 \approx 20$ %	$F_4 \approx 4$ %
$F_5 \approx 29$ %	$F_6 \approx 1$ %	$F_7 \approx 3,5$ %	$F_8 \approx 0,5$ %

Of the proportions of dewatering given above, the proportions taking place through the covering wire 10 are $F_3 + F_5 + F_6 = 50$ %, and the dewatering proportions taking place through the carrying wire 20 are $F_1 + F_2 + F_4 + F_7 + F_8 = 50$ %. As comes out from the above, in the invention a symmetric and equal dewatering is achieved through both of the wires 10 and 20, whereby the symmetry of the web structure is promoted. It is an essential feature and a difference compared with the applicant's prior-art "Speed-Former" concept that, in the invention, water is removed on the former roll 11;21 to a considerably lower extent than in the "Speed-Former", which contributes to an improved retention.

The consistencies, i.e. dry solids contents of the web that is being formed, which are indicated in Fig. 3, are preferably as follows:

- consistency in the headbox ≈ 0.5...1.7 %
- consistency before the forming shoe 12;22 = $k_1 \approx$ 0.6...1.9 %
- consistency after the forming shoe 12;22 and before the MB unit 50 = $k_2 \approx$ 0.90...3.0 %
- consistency after the MB unit 50 = $k_3 \approx$ 7...12 %
- consistency after the second forming roll 23 = $k_4 \approx$ 10...14 %

The various parameters in accordance with the invention that affect the web formation, such as the gap G geometry, the roll 11;21 diameters, the curve radius R_1 of the forming shoe 12;22, the pressures p_k,p_1,p_2 and p_4 that act upon the operation of the MB unit, the roll 23 diameter and the negative pressures in its suction zone 23a,23b, and the negative pressure in the suction zone 11a, if any, of the forming roll 11, are preferably chosen so that the dry solids contents $k_1...k_4$ defined above and given in the following table will be carried into effect.

Table

Dry solids content of the web, %	Widest range of dry solids content, %	Preferable dry solids content, %
k_1	0.6...1.9 %	~ 1.5 %
k_2	0.9...3.0 %	~ 2.2 %
k_3	7...12 %	~ 10 %
k_4	10...14 %	~ 13 %

In the following, the patent claims will be given, and the various details of the invention may show variation within the scope of the inventive idea defined in said claims and differ from what has been stated above for the sake of example only.

Claims

1. Gap former in a paper machine, comprising the loop of a carrying wire (20) and the loop of a covering

wire (10), which together form a twin-wire zone (B-C), which starts from the forming gap (G), into which the slice part (32) of the headbox feeds the pulp suspension jet (J), and after which twin-wire zone the web (W) is separated from the covering wire (10) and is transferred on the carrying wire (20) onto a pick-up fabric (31), **characteriz d** in that the twin-wire zone (B-C) comprises a combination of the following web-forming and dewatering units, which are placed in the given sequence in the running direction of the web (W) that is formed and which are known in themselves:

(a) a forming gap (G), which is defined, at one side, by one of the wires (10;20), which runs over the open face (11';21') of the first forming roll (11;21), and by the substantially straight run of the opposite wire (20;10), starting from its guide roll (21A;11A) to the next forming member (22;12);

(b) a forming shoe (12;22) provided with a curved ribbed deck (12a;22a), whose curve radius is $R_1 >$ 2...8 m, the tangential direction of the inlet side of the ribbed deck (12a;22a) of said forming shoe (12;22) substantially coinciding with the principal direction of the forming gap (G);

(c) a MB unit or units (50), comprising a dewatering unit (40) and a press and support unit (60) placed one opposite to the other, the sets of ribs (80,70) in said units pressing the web (W) to be formed between the wires (10,20); and

(d) a large-diameter (D_2) second forming roll (23), which includes a suction zone (23a) or suction zones (23a,23b), in or after the area of which suction zone (23a) the covering wire (10) is separated by means of the guide roll (14') from the web (W), which is passed further on the carrying wire (20).

2. Gap former as claimed in claim 1, **characterized** in that, in the twin-wire zone, the MB unit (50) or units is/are followed by a suction box (19;29), which is preferably placed inside the loop of the carrying wire (20).

3. Gap former as claimed in claim 1 or 2, **characterized** in that the guide roll (11A;21A) that determines the geometry of the forming gap (G) is placed, in the direction of feed of the pulp jet (J), before the first forming roll (21;11) and/or the outlet end of the forming gap (G) is placed, in vertical formers (Figs. 1 to 4), at or near the horizontal plane (T-T) placed through the centre of the first forming roll (11;21) and, in horizontal formers (Figs. 5 and 6), at or near the corresponding vertical plane.

4. Gap former as claimed in any of the claims 1 to 3, **characterized** in that the twin-wire zone is substantially vertically rising and that the centre of the first forming roll (11;21) is placed at a level by the vertical measure v_1 higher as compared with the centre of the opposite guide roll (21A;11A) of the second wire (20;10), which measure v_1 has been chosen in the range of $v_1 \approx 50...300$ mm, when the diameters D_1 of the rolls (11,21,11A,21A) that determine the geometry of the forming gap (G) have been chosen in the range of $D_1 \approx 0.5...1.5$ m.

5. Gap former as claimed in any of the claims 1 to 3, **characterized** in that the run of the twin-wire zone which runs through the MB unit is straight or curved with a large curve radius R_2, said curve radius being $R_2 \geqq 3...8$ m.

6. Gap former as claimed in any of the claims 1 to 5, **characterized** in that the diameter D_2 of the second forming roll (23) has been chosen in the range of $D_2 \approx 1...2$ m, and that in the second forming roll (23) there are at least two successive suction zones (23a,23b), of which the latter one ensures that the web (W) follows the carrying wire (20) while the web (W) is separated from the covering wire (10).

7. Gap former as claimed in any of the claims 1 to 6, **characterized** in that the principal direction of the twin-wire zone (B-C) is substantially horizontal, and that in the twin-wire zone (B-C), after the forming gap (G), inside the loop of the lower wire (20), there is a forming shoe (22), after it the MB unit (50), which is again followed by a second large-diameter forming roll (23), which is placed inside the loop of the lower wire (20), and after which the web (W) is separated from the upper wire (10) by means of a suction device (25) and is guided to follow the lower wire (20).

8. Gap former as claimed in claim 7, **characterized** in that the MB unit (50) comprises a dewatering unit (40), which is placed inside the loop of the upp r wir (10) and which comprises at least two successiv dewatering chambers (41,45), and that, inside the loop of the lower wire (20), undern ath th first dewatering chamber (41) of the MB unit, a forming shoe (22) provided with a curved deck (22a) is fitted, and ther after a press and support unit (60) of the MB unit, in which there is a set of ribs (70) that is loaded by the pr ssur s (p_k) of a medium (Fig. 6).

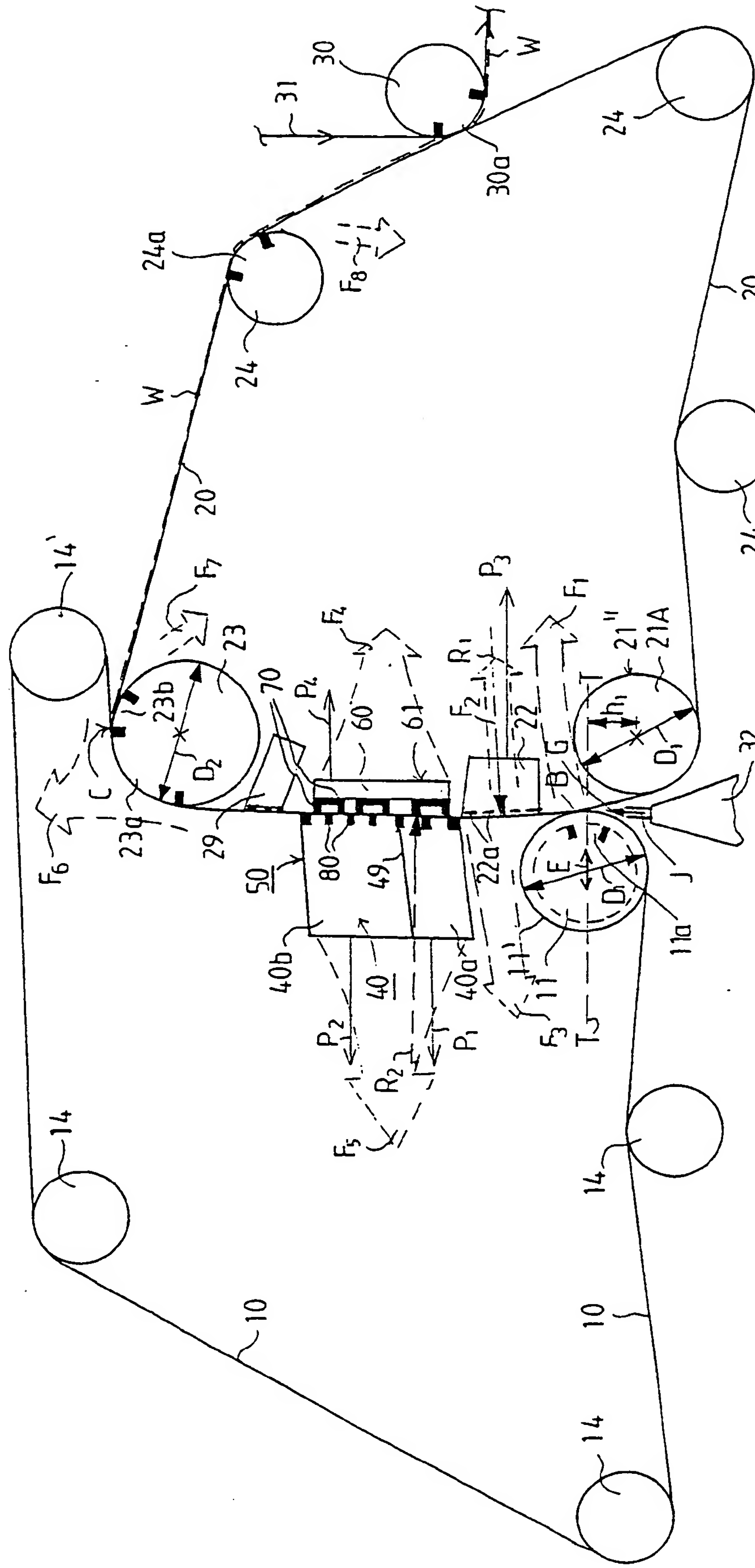
9. Gap former as claimed in any of the claims 7 or 8, **characterized** in that a suction-deflector duct (44) is passed into the first dewatering chamber (41) of the dewatering unit (40) placed inside the loop of the upper wire (10) in the MB unit (50), through which suction-deflector duct (44) water is transferred into the first chamber (41) out of the gap space (43) placed underneath, which water has been removed out of the web (W) through the slot gaps in the ribbed deck (22a) of the forming shoe (22) fitted substantially opposite to said gap space (43) and inside the loop of the lower wire (20), that the first dewatering chamber (41) is directly followed by a second dewatering chamber (45), in connection with whose bottom side there is a fixed set of ribs (80), through whose slot gaps water is removed through the water drain duct (47) of the second dewatering chamber (45), and that said dewatering chambers (41,45) communicate with the same or with different negative pressures (p_1,p_2), and that against said set of ribs (80), a set of loading ribs (70) operates, which operates by means of the pressure (p_k) of the pressure medium of the press and support unit (60) (Fig. 6).

10. Gap former as claimed in any of the claims 1 to 9, **characterized** in that the second forming roll (23) is placed inside the loop of the carrying wire (20) and that the first forming roll (11;21) is placed inside the loop of the covering wire (10) or of the carrying wire (20), and that the dewatering equipment (40) of the MB unit (50) is placed inside the loop of the covering wire (10) or of the carrying wire (20), and the loading and support unit (60) of the MB unit (50) is placed inside the opposite wire loop (20,10).

11. Gap former as claimed in any of the claims 1 to 10, **characterized** in that the dry solids content k_1 of the web (W) after the forming gap (G) before the first forming shoe (12,21) is $k_1 \approx 0.6...1.9$ %, preferably $k_1 \approx 1.5$ %, that the dry solids content k_2 of the web (W) after said forming shoe (12;21) and before the MB unit (50) is $k_2 \approx 0.9...3.0$ %, preferably $k_2 \approx 2.2$ %, that the dry solids content k_3 of the web (W) after the MB unit (50) and before the second forming roll (23) is $k_3 \approx 7...12$ %, preferably $k_3 \approx 10$ %, that the dry solids content k_4 of the web (W) after the second forming roll (23) is $k_4 \approx 10...14$ %, preferably $k_4 \approx 13$ %.

12. Gap former as claimed in any of the claims 1 to 11, **characterized** in that the web forming members have been arranged so that the proportions of dewatering taking place through the covering wire (10) and through the carrying wire (20) are substantially equal to one another and/or that the proportion of dewatering taking place on the first forming roll (11;21) is $F_1 \approx 15$ %, the proportion of dewatering taking place on the first forming shoe (22) towards the interior of the shoe is $F_2 \approx 27$ % and the proportion of dewatering taking place outwards is $F_3 \approx 20$ %, the proportion of dewatering taking place towards the press and support unit (60) of the MB unit (50) is $F_4 \approx 4$ % and the proportion of dewatering taking place towards the dewatering unit (40) of the MB unit is $F_5 \approx 29$ %, the proportion of dewatering taking place through the outer wire (10) in the area of the second forming roll is $F_6 \approx 1$ %, the proportion of dewatering taking place in the area of the second forming roll (23a) towards said roll is $F_7 \approx 3.5$ %, and the proportion of dewatering taking place in and after the area of the suction roll (24) through the carrying wire (20) is $F_8 \approx 0.5$ %.

13. Gap former as claimed in any of the claims 1 to 12, **characterized** in that, in the position of the MB unit (50) mentioned above, the former comprises two or more successive MB units, which are preferably arranged so that the dewatering unit (40) and the loading and support units (60), which operate one opposite to the other, are placed inside opposite wire loops (10,20) in the successive MB units (50).



10
14
14'
20
21A
22
22a
23
23a
23b
24
24a
29
30
30a
31
32
40
40a
40b
49
50
60
61
70
80
11
11a
W

FIG. 1

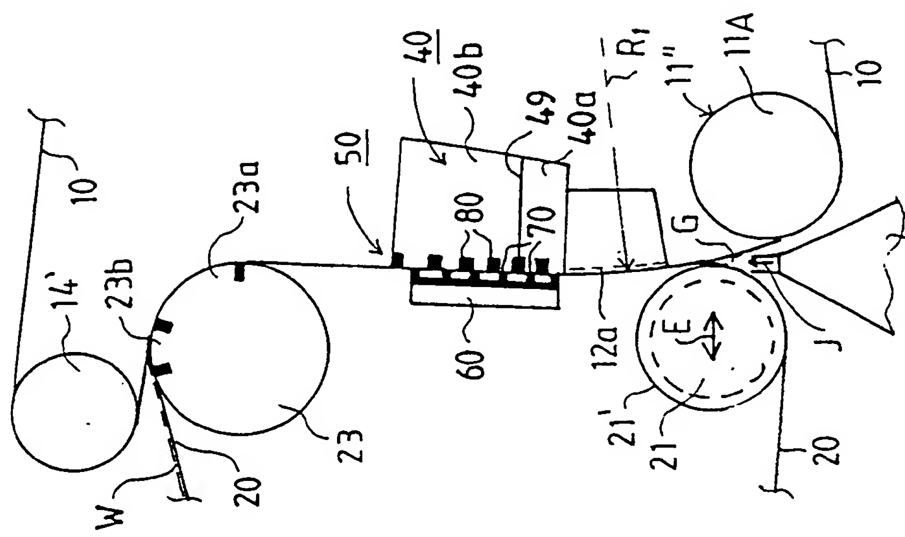


FIG. 4

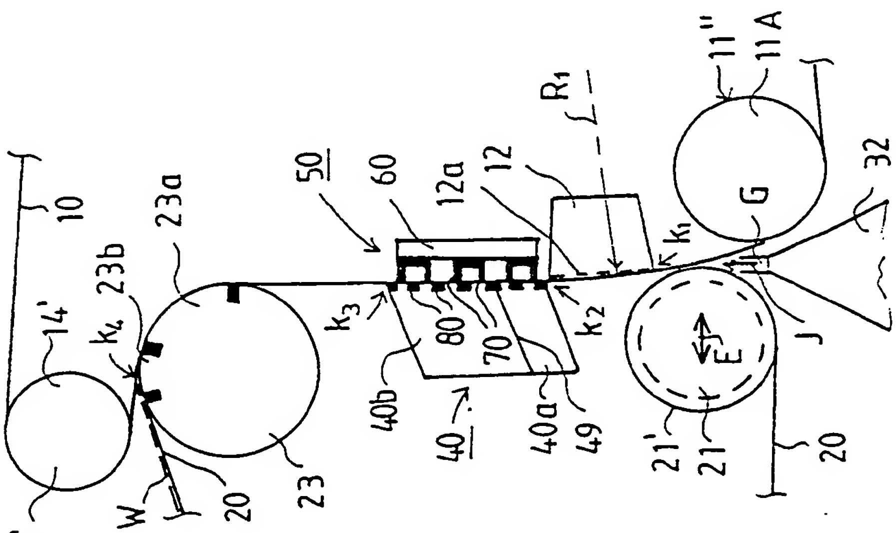


FIG. 3

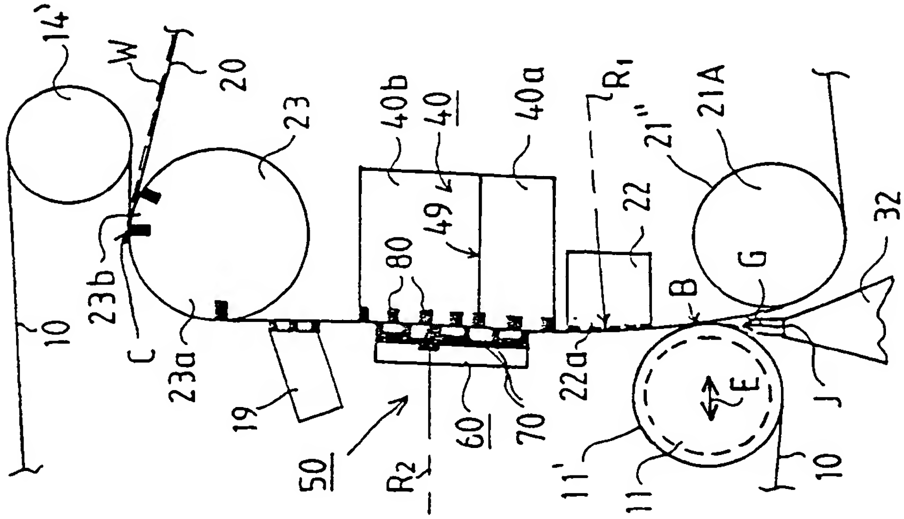
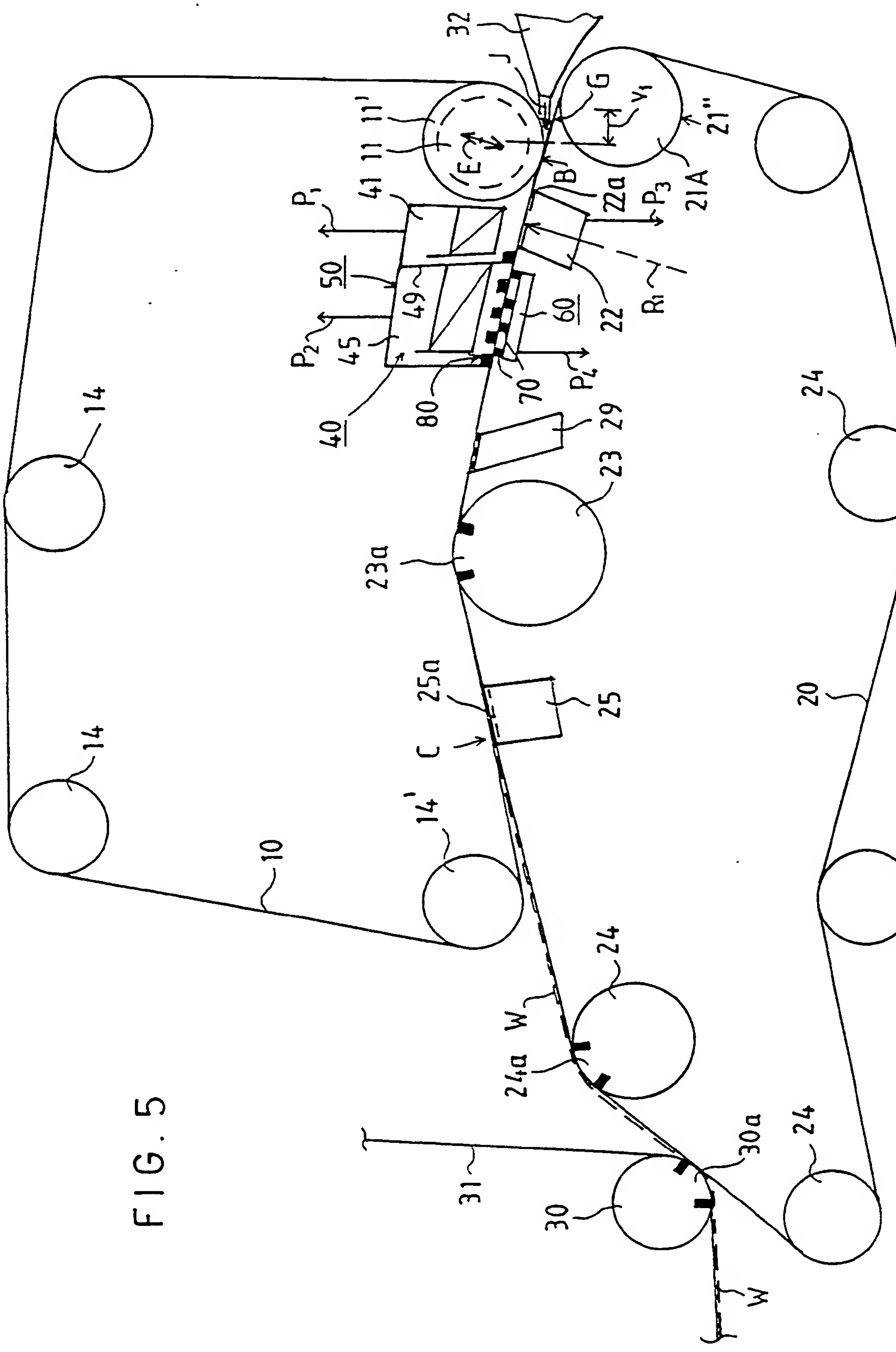


FIG. 2


32
J
G
V_1
11'
11
41
E
B
21''
21A
22a
P_1
P_3
50
49
60
22
R_1
P_2
45
70
P_4
40
80
29
14
24
23
23a
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C
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14'
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24a
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24
31
30
W

FIG. 5

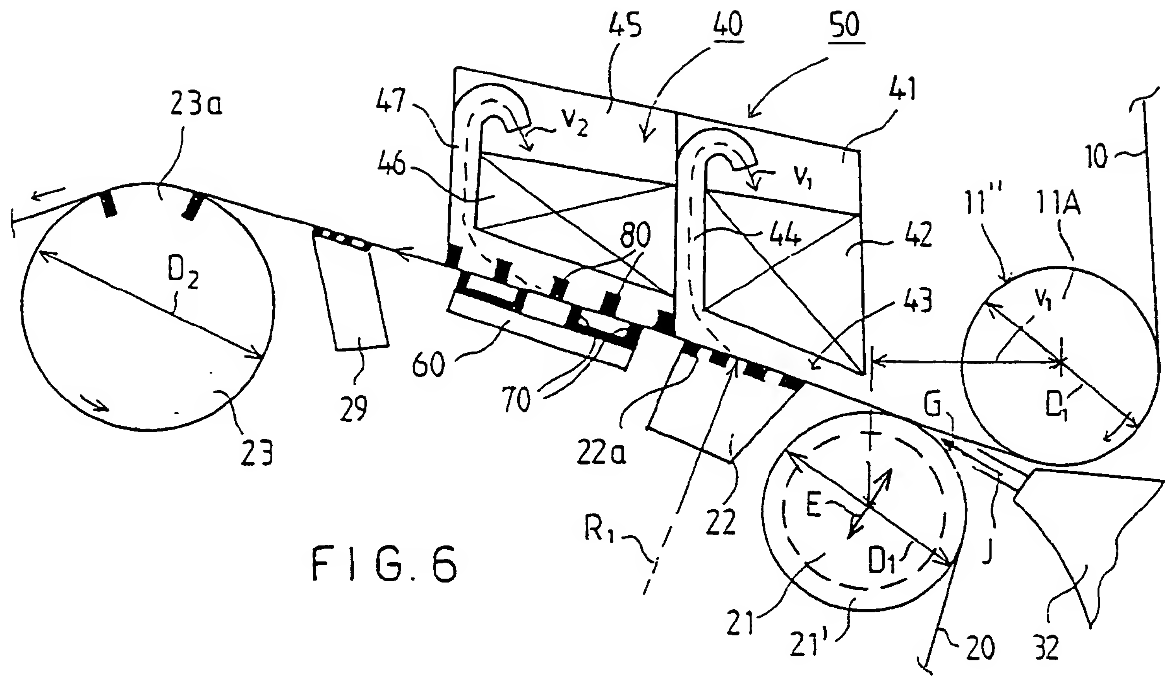

FIG.6

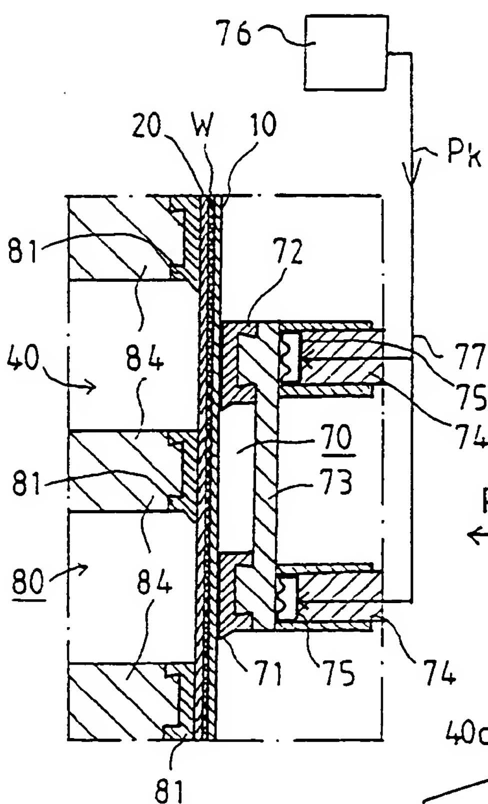

FIG.7A

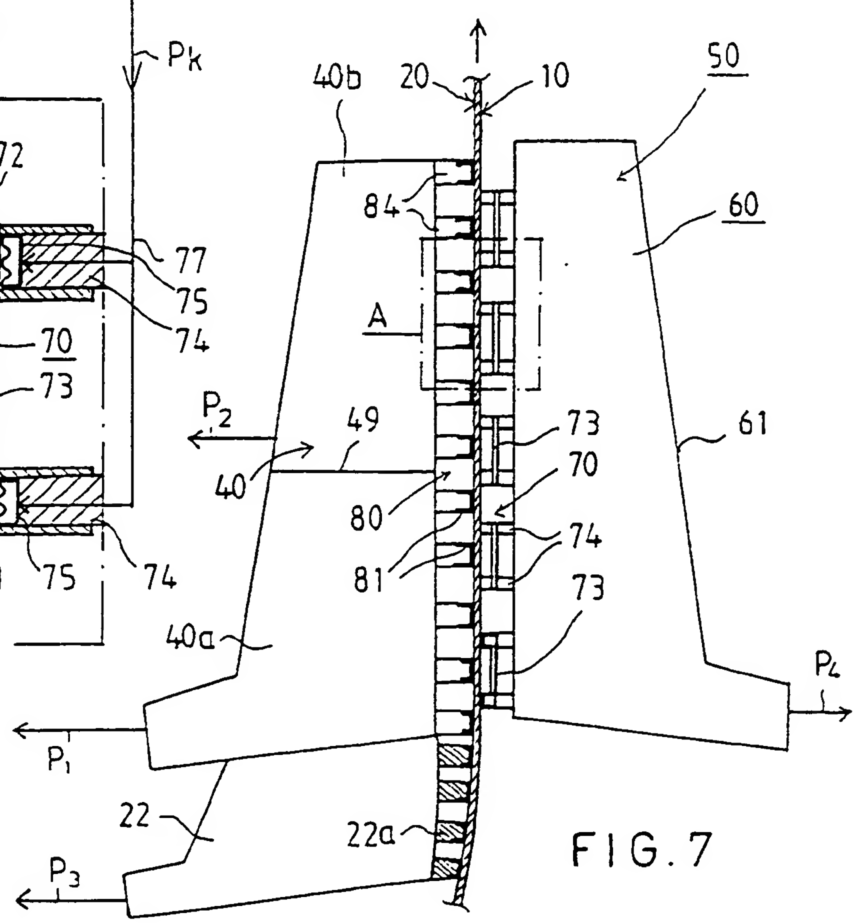

FIG.7

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 94 85 0085

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
X	EP-A-0 504 123 (VALMET PAPER MACHINERY INC.) * the whole document * ---	1,3,5-7, 13	D21F9/00
D,Y	WO-A-93 02250 (VALMET-TAMPELLA INC.) * the whole document * ---	1-3,5,7, 10	
Y	DE-U-91 05 797 (VOITH) * the whole document * ---	1-3,5,7, 10	
A	DE-U-91 15 632 (VOITH) * the whole document * ---	1-3,5, 7-9	
A	EP-A-0 515 964 (VOITH) * the whole document * ---	1-3,5	
P,A	EP-A-0 552 139 (VALMET PAPER MACHINERY INC.) * the whole document * -----	1,2,5,8, 9	TECHNICAL FIELDS SEARCHED (Int.Cl.5) D21F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	28 September 1994	De Rijck, F

CATEGORY OF CITED DOCUMENTS

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L : document cited for other reasons

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